

CHAPTER VII

CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

To improve the cathode materials for IT-SOFCs, A and B site substitution on Ni-based perovskite materials were successfully synthesized. In this research, the synthesis of $\text{La}_{2-x}\text{Sr}_x\text{NiO}_{4+\delta}$ ($x \leq 0.8$) via a simple room temperature sol-gel process using a water-based solvent in presence of some amounts of ethanolamine was successfully carried out. Suitable gelation time was in the range of 6-72 h, depending on the amount of Sr added. The substitution of Sr for La on the A-site affected the phase, sintering, and conducting behavior of the synthesized samples. The $\text{La}_{2-x}\text{Sr}_x\text{NiO}_{4+\delta}$ phase was more stable than La_2NiO_4 because Sr helped stabilize La_2NiO_4 structure. The sol-gel process yielded more homogenous powders with higher purity than the solid state technique leading to the better properties. In contrast, the new double perovskite materials, $\text{La}_3\text{Ni}_2\text{NbO}_9$ and $\text{La}_3\text{Ni}_2\text{TaO}_9$ were also successfully synthesized both by the solid state reaction and sol-gel process. But the solid state reaction was shown to yield the better phase formation, while the higher purities were obtained by the sol-gel process. Moreover, adding of Nb and Ta in $\text{La}_3\text{Ni}_2\text{MO}_9$ does not only influence on the phases, but also has an impact on the microstructure, especially in sintering behavior leading to the significant difference of the electrical conductivity.

In this work, the $\text{La}_{2-x}\text{Sr}_x\text{NiO}_{4+\delta}$ ($x \leq 0.8$) material was not only successfully synthesized by a simple room-temperature sol-gel process using a water-based solvent, but only $\text{La}_{1.2}\text{Sr}_{0.8}\text{NiO}_4$ shows a high conductivity as 160 S/cm at 500°C and high D^* as $2 \times 10^{-9} \text{ cm}^2\text{s}^{-1}$ at 800°C which seems to have high potential to be used as IT-SOFCs cathode. Although, the synthesis of $\text{La}_3\text{Ni}_2\text{NbO}_9$ and $\text{La}_3\text{Ni}_2\text{TaO}_9$ double perovskite materials were also successfully carried out, the $\text{La}_3\text{Ni}_2\text{NbO}_9$ and $\text{La}_3\text{Ni}_2\text{TaO}_9$ materials need further improvement because the primary results of the electrical conductivities are not yet suitable for use as IT-SOFCs cathode.

7.2 Recommendations

1. Further study of the mechanism on conduction of $\text{La}_{2-x}\text{Sr}_x\text{NiO}_{4+\delta}$ materials should be investigated.
2. Other appropriate amounts of B site substitution in $\text{La}_3\text{Ni}_{3-x}\text{M}_x\text{O}_9$ double perovskites should be examined.
3. Other appropriate types of B site dopants in $\text{La}_3\text{Ni}_{3-x}\text{M}_x\text{O}_9$ double perovskites also should be studied.